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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/786,338	03/08/2001	Tetsuhiro Tanabe	107400-00023	3864

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EXAMINER	
LOUIE, WAI SING	
ART UNIT	PAPER NUMBER
2814	

DATE MAILED: 06/20/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/786,338	TANABE ET AL.	
	Examin r	Art Unit	
	Wai-Sing Louie	2814	

-- The MAILING DATE of this communication appears on the cover sh et with the correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 April 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-65* is/are pending in the application.

4a) Of the above claim(s) *10,17,20,33-38,40-47,50,55 and 56* is/are withdrawn from consideration.

5)☒ Claim(s) *18 and 19* is/are allowed.

6)☒ Claim(s) *1-9,11-16,21-25,27,30-32,39,48,49,51-54 and 57-64* is/are rejected.

7)☒ Claim(s) *26,28,29 and 65* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *5* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-2, 4-6, 15-16, and 61-62 are rejected under 35 U.S.C. 102(e) as being anticipated by Kawasaki et al. (US 6,057,561).

With regard to claims 1-2, 5, and 62, Kawasaki et al. disclose an optical semiconductor element (col. 4, line 32 to col. 14, line 58 and fig. 32) comprising:

- A substrate 11 (col. 14, line 40);
- A light-emitting layer 14 forming portion disposed on the substrate 11 sandwiched between n-type cladding layer 13 and p-type cladding layers 15 made of material having a larger bandgap than the active layer 14, where the MQW active layer 14 is made of an oxide compound semiconductor containing ZnO/MgZnO (col. 13, line 42). The bandgap of MgZnO is larger than ZnO (Mg is inherently had larger bandgap than Zn). The light emits by electric current injection is inherent and it is written in functional language, which does not carry any patentable weight.

With regard to claims 4 and 61, Kawasaki et al. disclose the active layer is made of $Cd_xZn_{1-x}O$, where $o \leq x < 1$ (col. 11, lines 28-59).

With regard to claim 6, Kawasaki et al. disclose the cladding layers are made of $Mg_xZn_{1-x}O$, where $o \leq x < 1$ (col. 13, line 42).

With regard to claims 15-16, Kawasaki et al. disclose a low temperature ZnO layer 6 (col. 11, lines 66-67) is disposed in between the active layer 5 and an upper cladding layer 7 (col. 13, line 25 and fig. 31). The ZnO layer 6 is 70 nm in thickness (col. 12, line 24).

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claim 27 is rejected under 35 U.S.C. 102(b) as being anticipated by Tischler (US 5,661,074).

With regard to claim 27, Tischler discloses an electroluminescence device (col. 5, line 16 to col. 15, line 15 and fig. 4) comprising:

- A substrate 37 (fig. 4);
- A reflective film 36 for reflecting light from a front surface side of the substrate 37 (fig. 4), where the reflective film 36 is laminated by an even number of dielectric films having different refractive indices with a thickness of $\lambda/(4n)$, where n is a refractive index of the dielectric film, and λ is a light emission wavelength on the substrate 37 (col. 11, lines 17-38). It is the inherent function of a Bragg reflector to have a smaller refractive index and a layer having a larger refractive index are alternately laminated in this order;

- A semiconductor laminate section 32-35 (fig. 4), where semiconductor layers are laminated on the reflective film 36 to form a light-emitting layer.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 3, 7-8, 11-13, 21-25, 52, 60, and 64 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kawasaki et al. (US 6,057,561) in view of Rennie et al. (US 5,889,295).

With regard to claims 3, 52, 60, and 64, Kawasaki et al. do not disclose the cladding layers are made of Group III nitride compound semiconductor. However, Rennie et al. disclose an undoped ZnO MQW and AlGaN cladding Layers (Rennie fig. 18). Rennie et al. teach the conductive oxide such as ZnO exhibits a good ohmic property relative to p-GaN and n-GaN based compound semiconductor (Rennie col. 3, lines 57-60 and col. 4, lines 31-35). Therefore, it would have been obvious at the time the invention was made to modify Kawasaki's device with the teaching of Rennie et al. to provide Group III nitride compound semiconductor as cladding layers.

With regard to claims 7-8, Kawasaki et al., modified by Ronnie et al. in claim 3 above, would disclose the GaN base cladding layers sandwiching the MQW active layer and the substrate is made of sapphire (Ronnie fig. 18).

With regard to claim 11, Kawasaki et al. disclose the active layer is a $Cd_xZn_{1-x}O/ZnO$ quantum well structure, but do not disclose a stress-alleviating layer disposed on at least one side of the n-type cladding layer. However, one skilled in the art would provide a buffer to relieve the stress and strain between the substrate and the light-emitting structure such as disclosed in Ronnie et al. (Ronnie fig. 19). Therefore, it would have been obvious to have a ZnO buffer layer in Kawasaki's device. Inherently, ZnO has a wider bandgap than CdZnO.

With regard to claims 12-13, 21, in addition to the limitations in claims 1 and 9 above, Kawasaki et al. also disclose:

- Kawasaki et al., modified by Ronnie et al. in claim 11 above, would disclose a ZnO buffer (stress-alleviating) layer, but do not disclose the layer is made of $Mg_xZn_{1-x}O$, where $o \leq x < 1$. However, Kawasaki et al. teach the Group II-oxide could include other Group II elements such as Cd or Mg (col. 1, lines 23-48). Therefore, it would have been obvious the buffer layer could be $Mg_xZn_{1-x}O$.

With regard to claim 22, Kawasaki et al., modified by Ronnie et al. in claim 21 above, do not disclose the thickness of the ZnO buffer layer. Since the applicant has not established the criticality of the thickness stated and since this value are in common use in similar devices in the art, it would have been obvious to one of ordinary skill in the art to use these values in the thickness of the device. Where patentability is said to be based upon particular chosen dimension or upon another variable recited in a claim, the applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

With regard to claim 23, it is written in method format, which does not carry any patentable weight.

With regard to claim 24, in addition to the limitations in claims 1 and 9 above, Kawasaki et al. also disclose:

- Kawasaki et al., modified by Ronnie et al. in claim 11 above, would disclose a sapphire substrate, a ZnO buffer (stress-alleviating) layer, and a semiconductor light-emitting structure with n-type and p-type layers sandwiching the active layer. However, the difference in thermal expansion coefficient between the lowest most light-emitting structure and the buffer layer and the substrate are not mentioned. Since the structure recited in the reference is substantially identical to that of the claims, the claimed properties are presumed to be inherent. Where the claimed and the prior art products are identical or substantially identical in structure, or are produced by identical or substantially identical processes, a *prima facie* case of either anticipation or obviousness has been established. *In re Best*, 195 USPQ 430, 433 (CCPA 1977).

With regard to claim 25, Kawasaki et al. disclose the substrate 11 is made of sapphire and the lowermost layer 13 is made of ZnO-based semiconductor compound having a wurtzite structure (col. 5, lines 11-15).

Claims 9, 48-49, and 57 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kawasaki et al. (US 6,057,561).

With regard to claim 9, in addition to the limitations in claim 1 above, Kawasaki et al. also disclose:

- Kawasaki et al. teach the optical semiconductor element is made of Group II-oxide, which comprises zinc oxide film containing cadmium (col. 2, lines 41-44). Therefore, it would have been obvious the MQW active layer 14 could be made of $Cd_xZn_{1-x}O/ZnO$;
- The cladding layers 13 and 15 are made of $Mg_yZn_{1-y}O$ (col. 13, lines 40-42).

With regard to claims 48-49, in addition to the limitations in claim 1 above, Kawasaki et al. also disclose:

- Kawasaki et al. disclose the ZnO-based compound semiconductor layers are grown by MOCVD process (col. 6, line 3). The metal organic chemical vapor deposition uses organic metal compound. Therefore, it would have been obvious containing C element in the compound.

With regard to claim 57, in addition to the limitations in claims 1 and 9 above, Kawasaki et al. also disclose:

- An i-layer made of ZnO/MgZnO compound semiconductor MQW structure (col. 13, line 42), but do not disclose the ZnO-based layer is semi-insulating. However, the MQW structure comprises an undoped well layer sandwiched by the undoped barrier layers, which are insulating the well layer. Therefore, it would have been obvious the undoped well layer is insulated;
- An electrically conductive layer disposed on a front surface of the i-layer (col. 13, line 44).

Claims 14, 39, 51, 53-54, and 58-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kawasaki et al. (US 6,057,561) modified by Rennie et al. (US 5,889,295) as applied to claim 3 above, and further in view of Okazaki et al. (US 5,966,396).

With regard to claim 14, Kawasaki et al. modified by Rennie et al. would disclose the cladding layers 13 and 15 are made of $Mg_yZn_{1-y}O$ (col. 13, lines 40-42) and a ZnO buffer layer on top of the substrate (Ronnie fig. 19), but do not disclose an optical waveguide is disposed between the n-type and p-type side of the active layer 14. However, it is well known to provide waveguide layers in the light-emitting structure for light confinement such as disclose in Okazaki et al. (Okazaki fig. 1). Therefore, it would have been obvious to have waveguide layers in Kawasaki's device.

With regard to claim 39, in addition to the limitations in claim 1 above, Kawasaki et al. and Rennie et al. also disclose:

- Kawasaki et al. modified by Rennie et al. do not disclose a p-type layer contains an element capable of becoming an n-type dopant as a buffering agent. However, it is well known to provide an n-dopant in a p-region in order to form a current blocking layer such as disclosed in Okazaki et al. (layer 213 in fig. 7). Therefore, it would have been obvious to provide an n-dopant in a p-region in order to form a current blocking layer in Kawasaki's device.

With regard to claims 51, 58, in addition to the limitations in claims 1 and 39 above, Kawasaki et al. and Rennie et al. also disclose:

- Kawasaki et al. modified by Okazaki et al. would disclose a current blocking (constriction) layer, but do not disclose using Group IA or VB element as dopant.

However, ZnO-based semiconductor compound is a Group II-VI compound. Therefore, it would have been obvious the p-type dopant must be Group I.

With regard to claim 53, Kawasaki et al. disclose the light-emitting structure is ZnO-based semiconductor compound. The cladding layer is $Mg_xZn_{1-x}O$ (see claim 6 above). Therefore, it would have been obvious the current constriction layer could be made of $Mg_xZn_{1-x}O$.

With regard to claim 54, in addition to the limitations in claims 1, 39, and 54 above, Kawasaki et al. and Rennie et al. also disclose:

- Kawasaki et al. disclose light-emitting structure is made of ZnO-based compound, which including other elements such as Cd and Mg (see claims 4, 6, and 9 above). The etching stopping layer, such as layer 13 (n-contact layer) for forming the light-emitting mesa, could be a $Cd_xZn_{1-x}O$ layer.

With regard to claim 59, Kawasaki et al. disclose the ZnO-based semiconductor compound is a Group II-VI compound. Therefore, it would have been obvious the n-type dopant must be Group IIIA or IIIB element.

Claims 30 and 63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kawasaki et al. (US 6,057,561) in view of McTeer (US 5,700,718).

With regard to claims 30-32 and 63, in addition to the limitations in claim 1 above, Kawasaki et al. also disclose:

- An n-side electrode 12 disposed in contacted with the n-type ZnO-based compound semiconductor layer 13, but do not disclose the n-side electrode 12 is formed of Ti or Cr, where the electrode contact portion does not contain Al. However, it is well known to form an n-electrode with layers of metals such as disclosed in McTeer, which includes Ti contact and Al contact (McTeer col. 3, lines 6-8). Therefore, it would have been obvious to provide the n-side electrode having a Ti contact where there is no Al in Kawasaki's device.

With regard to claims 31-32, Kawasaki et al. modified by McTeer disclose the n-side contact is a titanium layer 16 and an aluminum layer 18 (McTeer col. 5, lines 43-46). An annealing treatment is performed and a Ti and Al alloy is formed (McTeer col. 5, lines 52-62).

Claim Objections

Claims 26, 28-29, and 65 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Allowable Subject Matter

Claims 18-19 are allowed. The following is an examiner's statement of reasons for allowance:

The claimed invention is a semiconductor light-emitting device comprising:

- A sapphire substrate;
- A buffer layer made of an Al_2O_3 film disposed on the sapphire substrate;
- A light-emitting layer forming portion made of ZnO-based compound semiconductor disposed on the buffer layer, the light-emitting layer forming portion including at least n-type and p-type layers to form a light-emitting layer.

Reference Hooper (US 6,270,574) discloses growing a GaAs buffer layer on a GaAs substrate may have some inhomogeneities (Hooper col. 2, lines 15-25). Reference Kizuki et al. disclose epitaxially growth a thin GaN buffer layer on a GaN substrate could produce a high crystalline quality buffer layer (Kizuki col. 3, lines 20-27). However, there is no teaching of a sapphire buffer thin film disposed on a sapphire substrate would produce a high crystalline quality buffer layer. Claims 18-19 are allowed.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wai-Sing Louie whose telephone number is (703) 305-0474. The examiner can normally be reached on 7:30 AM to 4:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (703) 308-4918. The fax phone numbers for the

organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

LONG PHAM
PRIMARY EXAMINER

wsl
June 6, 2003